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## DWARFMISTLETOE SURVEY IN WESTERN MONTANA

Donald P. Graham <sup>1</sup>

### ABSTRACT

The distribution and frequency of infection by dwarfmistletoes in a portion of western Montana was determined by a survey of 2,090 sample plots in the Clark Fork Unit, which includes some 3,400,000 acres of commercial timberland. Dwarfmistletoes were present in 23 percent of the plots. Ten percent of the 22,863 trees on all plots were infected, but 38 percent of the trees on the 474 infected plots had dwarfmistletoes. Data on frequency of infection are compiled and classified by county, timber type, and tree-size class.

### INTRODUCTION

Dwarfmistletoes (*Arceuthobium* spp.) are recognized as one of the worst enemies of coniferous tree species and are widely distributed in western North America. They can drastically reduce both the growth potential and yield of timber stands. The distribution and severity of infection must be known before the full effect of dwarfmistletoes on growth and yield can be determined. As the harvesting of timber has increased during recent years, the need for quantitative information about dwarfmistletoes has also increased.

To meet this need, a portion of western Montana called the Clark Fork Unit was surveyed in 1958. The Clark Fork area includes most of the Clark Fork River drainage between the Continental Divide and the Montana-Idaho line (fig. 1). This dwarfmistletoe survey was made in cooperation with the Division of Forest Economics Research of the Intermountain Forest and Range Experiment Station and Region 1 of the Forest Service as part of an economic study to evaluate the <sup>2</sup> timber management needs and industrial potential of the Clark Fork River drainage.

<sup>1</sup> Now with the Division of Timber Management, Region 6, U.S. Forest Service, Portland, Oregon.

<sup>2</sup> Hutchison, S. Blair, and Arthur L. Roe. Management for commercial timber--Clark Fork Unit, Montana. Intermountain Forest and Range Expt. Sta. Res. Paper 65, 32 pp., illus. 1962.



Figure 1. --Clark Fork Unit of western Montana, with county boundaries.

infection severity were used (see Appendix). In addition to the tree tally, the timber type within the sample plot boundary was determined.

## RESULTS

On the 2,090 plots, we recorded data from 22,863 trees, of which 48 percent were mature, 31 percent were pole-sized, and 21 percent saplings. Sixty percent of the plots were located in sawtimber, 35 percent in pole, and 5 percent in sapling stands. All plots were classified according to timber type so that results of this survey could complement forest inventory data compiled for the whole Clark Fork Unit. Forty-one percent of the plots were classified as Douglas-fir timber type, 10 percent as larch, 28 percent as lodgepole pine, and 21 percent as other timber types.

## EXTENT AND ABUNDANCE OF DWARFMISTLETOES

Dwarf mistletoes were common on Douglas-fir (*Pseudotsuga menziesii*), western larch (*Larix occidentalis*), and lodgepole pine (*Pinus contorta*). Douglas-fir dwarf mistletoe (*Arceuthobium douglasii*) was found only in the western part of the Clark Fork Unit, mostly west of the Mission and Sapphire mountain ranges. Infection in western larch and lodgepole pine trees was

## SURVEY METHOD

The general survey plan required an extensive sample of individual townships. Each township in the commercial forest zone was assigned a number. All townships that were inaccessible or that contained less than 50 percent commercial forest land were eliminated from the survey. Two hundred and nine townships, about 80 percent of those remaining, were then selected on a random scheme for the survey.

Each township was sampled at 10 locations, which were spaced at 10-chain intervals along a line. The start of each survey line was predetermined on maps from a point on the road nearest to the center of the township. The cardinal compass direction--north, south, east, or west--from this point to the township center was chosen as the bearing of the line.

At each of the 2,090 plots, we recorded detailed information from three concentric circular areas: a 1/5-acre area for sawtimber trees, a 1/50-acre area for pole-sized trees, and a 1/500-acre area for saplings. Trees were tallied on each plot by species, size class, and severity of dwarf mistletoe infection. Three tree-size classes and five classes of dwarf mistletoe

found wherever these host species occurred except in a few local areas. Most of the larch dwarfmistletoe (A. campylopodium forma laricis) was in the extreme western part of the Unit, but most of the lodgepole pine dwarfmistletoe (A. americanum) was in the eastern part, where lodgepole pine stands are extensive. The other tree species, including ponderosa pine (Pinus ponderosa), were free of infection except for an occasional single tree or groups of several trees. Infected trees of these other species were found in heavily infected stands of Douglas-fir, western larch, or lodgepole pine. The dwarfmistletoes that infect trees in the Clark Fork area were previously described by Kimmey and Graham.<sup>3</sup>

Nearly one-fourth of the 2,090 plots had some infection. It was most prevalent in Missoula County, where 27 percent of the plots had infected trees, and was least prevalent in Mineral County, where only 15 percent of the plots contained infection (table 1). Dwarfmistletoes were found in 36 percent of the 208 plots in the larch timber type. Corresponding values in the Douglas-fir and lodgepole pine types were 25 percent of 858 plots and 21 percent of 576 plots, respectively. Fourteen percent of the plots in other timber types had infected trees, but the infection was usually light.

Table 1.--Number of plots examined and percentage of plots infected, by county and timber type

| County                            | Timber type |         |               |                 |                |         |        |         |           |         |
|-----------------------------------|-------------|---------|---------------|-----------------|----------------|---------|--------|---------|-----------|---------|
|                                   | Douglas-fir |         | Western larch |                 | Lodgepole pine |         | Other  |         | All types |         |
|                                   | Number      | Percent | Number        | Percent         | Number         | Percent | Number | Percent | Number    | Percent |
| Deerlodge-Silverbow <sup>1</sup>  | 24          | 12      | 0             | <sup>2</sup> -- | 60             | 18      | 6      | 17      | 90        | 17      |
| Lewis & Clark-Powell <sup>1</sup> | 128         | 11      | 11            | 27              | 106            | 28      | 35     | 14      | 280       | 19      |
| Granite                           | 78          | 10      | 0             | --              | 125            | 29      | 22     | 9       | 225       | 20      |
| Lake                              | 24          | 0       | 37            | 32              | 4              | 25      | 25     | 16      | 90        | 19      |
| Mineral                           | 87          | 18      | 18            | 44              | 61             | 5       | 44     | 11      | 210       | 15      |
| Missoula                          | 227         | 33      | 67            | 31              | 82             | 23      | 104    | 12      | 480       | 27      |
| Ravalli                           | 135         | 36      | 0             | --              | 44             | 34      | 106    | 8       | 285       | 25      |
| Sanders                           | 155         | 32      | 75            | 43              | 94             | 6       | 106    | 22      | 430       | 26      |
| All counties                      | 858         | 25      | 208           | 36              | 576            | 21      | 448    | 14      | 2,090     | 23      |

<sup>1</sup> Because of similar forest and dwarfmistletoe conditions, results from these counties were combined.

<sup>2</sup> Timber type was not represented on plots in this county.

### FREQUENCY OF INFECTION BY DWARFMISTLETOES

Data collected from individual trees on the plots furnished a detailed appraisal of frequency of dwarfmistletoe infection. Ten percent of all 22,863 trees on the 2,090 plots had infection (table 2). By comparison, dwarfmistletoes were present on 38 percent of 5,903 trees in the 474 infected plots (table 3).

<sup>3</sup> Kimmey, James W., and Donald P. Graham. Dwarfmistletoes of the Intermountain and Northern Rocky Mountain Regions and suggestions for control. Intermountain Forest and Range Expt. Sta. Res. Paper 60, 19 pp., illus. 1960.

Table 2. --Percentage of trees infected on all plots by county, timber type, and severity of infection

| County and<br>timber type       | Total<br>trees | Severity             |                        |         | Total |
|---------------------------------|----------------|----------------------|------------------------|---------|-------|
|                                 |                | Light to<br>moderate | Heavy to<br>very heavy | Percent |       |
| <u>Deerlodge-Silverbow</u>      |                |                      |                        |         |       |
| Douglas-fir                     | 178            | 0                    | 1                      | 1       |       |
| Lodgepole pine                  | 536            | 13                   | 7                      | 20      |       |
| Other types                     | 39             | 0                    | 0                      | 0       |       |
| All types                       | 753            | 10                   | 5                      | 15      |       |
| <u>Lewis &amp; Clark-Powell</u> |                |                      |                        |         |       |
| Douglas-fir                     | 1,605          | 2 T                  | 1                      | 1       |       |
| Western larch                   | 130            | 5                    | 5                      | 10      |       |
| Lodgepole pine                  | 1,246          | 11                   | 7                      | 18      |       |
| Other types                     | 443            | T                    | 2                      | 2       |       |
| All types                       | 3,424          | 5                    | 3                      | 8       |       |
| <u>Granite</u>                  |                |                      |                        |         |       |
| Douglas-fir                     | 1,064          | 1                    | T                      | 1       |       |
| Lodgepole pine                  | 1,520          | 10                   | 8                      | 18      |       |
| Other types                     | 309            | 1                    | 0                      | 1       |       |
| All types                       | 2,893          | 5                    | 5                      | 10      |       |
| <u>Lake</u>                     |                |                      |                        |         |       |
| Douglas-fir                     | 332            | 0                    | 0                      | 0       |       |
| Western larch                   | 513            | 7                    | 1                      | 8       |       |
| Lodgepole pine                  | 36             | 8                    | 6                      | 14      |       |
| Other types                     | 348            | 2                    | 1                      | 3       |       |
| All types                       | 1,229          | 4                    | 1                      | 5       |       |
| <u>Mineral</u>                  |                |                      |                        |         |       |
| Douglas-fir                     | 877            | 3                    | 4                      | 7       |       |
| Western larch                   | 224            | 2                    | 9                      | 11      |       |
| Lodgepole pine                  | 555            | 1                    | T                      | 1       |       |
| Other types                     | 443            | 1                    | 1                      | 2       |       |
| All types                       | 2,099          | 2                    | 3                      | 5       |       |
| <u>Missoula</u>                 |                |                      |                        |         |       |
| Douglas-fir                     | 2,566          | 7                    | 9                      | 16      |       |
| Western larch                   | 906            | 7                    | 6                      | 13      |       |
| Lodgepole pine                  | 864            | 5                    | 3                      | 8       |       |
| Other types                     | 920            | 3                    | 2                      | 5       |       |
| All types                       | 5,256          | 6                    | 6                      | 12      |       |
| <u>Ravalli</u>                  |                |                      |                        |         |       |
| Douglas-fir                     | 1,297          | 9                    | 9                      | 18      |       |
| Lodgepole pine                  | 378            | 7                    | 10                     | 17      |       |
| Other types                     | 689            | 1                    | 1                      | 2       |       |
| All types                       | 2,364          | 6                    | 7                      | 13      |       |
| <u>Sanders</u>                  |                |                      |                        |         |       |
| Douglas-fir                     | 1,711          | 6                    | 5                      | 11      |       |
| Western larch                   | 893            | 10                   | 7                      | 17      |       |
| Lodgepole pine                  | 896            | 2                    | 2                      | 4       |       |
| Other types                     | 1,345          | 3                    | 2                      | 5       |       |
| All types                       | 4,845          | 5                    | 4                      | 9       |       |
| <u>All counties</u>             |                |                      |                        |         |       |
| Douglas-fir                     | 9,630          | 5                    | 5                      | 10      |       |
| Western larch                   | 2,671          | 8                    | 5                      | 13      |       |
| Lodgepole pine                  | 6,031          | 8                    | 5                      | 13      |       |
| Other types                     | 4,531          | 2                    | 2                      | 4       |       |
| All types                       | 22,863         | 5                    | 5                      | 10      |       |

<sup>1</sup> Percentages for "All types" are weighted averages. <sup>2</sup> "T" means less than one-half of 1 percent.

Table 3.--Numbers of plots infected, total trees on plots, and percent of trees infected, by timber type

| Timber type      | Infected plots | Total trees | Percent infected |
|------------------|----------------|-------------|------------------|
| Douglas-fir      | 216            | 2,361       | 39               |
| Western larch    | 76             | 1,150       | 30               |
| Lodgepole pine   | 121            | 1,545       | 51               |
| Other types      | 61             | 847         | 20               |
| All timber types | 474            | 5,903       | <sup>1</sup> 38  |

<sup>1</sup> Weighted average.

The number of trees infected was low in all counties--from only 5 percent in Lake and Mineral Counties to 15 percent in the Deerlodge-Silverbow area (table 2). Infection was found in 11 percent of the sawtimber trees, 9 percent of the pole-sized trees, and 7 percent of the saplings (table 4).

Table 4.--Percentage of trees infected on all plots, by timber type and tree-size class

| Timber type and tree-size class | Total trees   | Percent infected |
|---------------------------------|---------------|------------------|
| <u>Douglas-fir</u>              |               |                  |
| Sawtimber                       | 5,666         | 11               |
| Pole                            | 2,276         | 8                |
| Sapling                         | 1,688         | 8                |
|                                 | <u>9,630</u>  |                  |
| <u>Western larch</u>            |               |                  |
| Sawtimber                       | 1,282         | 19               |
| Pole                            | 657           | 12               |
| Sapling                         | 732           | 3                |
|                                 | <u>2,671</u>  |                  |
| <u>Lodgepole pine</u>           |               |                  |
| Sawtimber                       | 1,498         | 18               |
| Pole                            | 2,974         | 12               |
| Sapling                         | 1,559         | 11               |
|                                 | <u>6,031</u>  |                  |
| <u>Other timber types</u>       |               |                  |
| Sawtimber                       | 2,553         | 4                |
| Pole                            | 1,144         | 3                |
| Sapling                         | 834           | 3                |
|                                 | <u>4,531</u>  |                  |
| <u>All timber types</u>         |               |                  |
| Sawtimber                       | 10,999        | 11               |
| Pole                            | 7,051         | 9                |
| Sapling                         | 4,813         | 7                |
|                                 | <u>22,863</u> |                  |

Infected trees accounted for 13 percent of all trees in the larch and lodgepole pine types, respectively (table 2), but 30 percent of the trees in infected larch plots and 51 percent of the trees in infected lodgepole pine plots had dwarfmistletoes (table 3). Ten percent of all trees in the Douglas-fir type had infection, but dwarfmistletoes were found in 39 percent of the trees in infected plots in this type.

#### DISCUSSION

This survey showed that dwarfmistletoes pose a problem in management of only three tree species in the Clark Fork drainage of western Montana. But the parasites are not uniformly distributed throughout the drainage. This lack of uniform distribution should serve as a warning to forest managers. Whenever forest inventories are made for management purposes, distribution of dwarfmistletoes should be carefully mapped by host species, intensity of infection, and stand characteristics.

Douglas-fir dwarfmistletoe was most abundant in Ravalli and Missoula Counties, larch dwarfmistletoe in Mineral and Sanders Counties, and lodgepole pine dwarfmistletoe in Deer-lodge, Silverbow, Lewis and Clark, and Powell Counties. Dwarfmistletoes were most frequent in the larch timber type, intermediate in the Douglas-fir and lodgepole pine types, and lowest in other timber types. In the Douglas-fir, larch, and lodgepole pine timber types, the species that determined the type usually was most frequently and severely infected.

The lower frequency and lighter intensity of infection in timber types other than Douglas-fir, larch, or lodgepole pine had been expected and was confirmed (table 1). The primary host species (Douglas-fir, larch, and lodgepole pine) were often scattered through the other timber types, but were a minor component of them. Most of the infection in these types is attributed to presence of infected Douglas-fir trees in the ponderosa pine type, infected lodgepole pine trees in the Engelmann spruce and subalpine fir types, and infected larch trees in the grand fir, western hemlock, western redcedar, and western white pine types.

The lowest frequency and lowest intensity of dwarfmistletoes were found in the sapling class. Small trees expose less target area for reception of seeds than large trees and are often screened from sources of infection by intervening trees. Also, small trees are usually rather young and consequently have been exposed to infection for less time than large trees.

Since the survey was extensive but not designed to determine growth impact losses, the results can be assessed only in general terms for large areas. For purposes of starting control projects, more intensive surveys will be required. However, general knowledge about impact on growth, spread, and intensification of dwarfmistletoes suggests that stands in the Clark Fork Unit have more infection than can be tolerated if future needs for timber products are to be filled.

## APPENDIX

### EXPLANATION OF TERMS USED WITH RECORDED DATA

#### Tree-size class:

Sawtimber = trees 11.0 inches d.b.h. or larger  
Poletimber = trees 5.0 to 10.9 inches d.b.h.  
Saplings = trees 2.0 feet high to 4.9 inches d.b.h.

#### Dwarf mistletoe severity:

Severity of infection in each tree was determined by dividing live crown into two equal parts. Each half was rated as:

0 = no infection  
1 = less than one-third of the branches infected  
2 = more than one-third of the branches infected

These numbers were added to give an overall rating for the tree:

0 = dwarf mistletoe free  
1 = lightly infected  
2 = moderately infected  
3 = heavily infected  
4 = very heavily infected

#### Timber type:

Based on the tree species predominant on the plot using cubic-foot volume of sawtimber-sized trees on plots classified as sawtimber, cubic-foot volume of pole-sized trees on plots classified as poletimber, and number of stems on plots classified as saplings.

